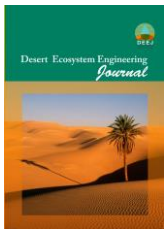
DEEJ (2020) 9 (26) 73-86

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: http://deej.kashanu.ac.ir



Evaluating Wind Erosion Intensity through Performance Assessment of Bayesian Belief Networks: A Case Study of Isfahan Province

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Received: 16/05/2018 Accepted: 22/12/2019

Extended Abstract

Introduction: Wind erosion is one of the important aspects of land degradation in arid and semi-arid areas. Countries located in arid and semiarid belt of the world including Iran have always been faced with this phenomenon. Wind erosion assessment models use different scores to determine the erosion rate in a given class. However, due to the spatial and temporal complexities and the multiplicity of factors affecting the ecological conditions of the region, it is impossible to fully rely on such results and use them for targeting and prioritizing the areas and providing suitable solutions for their management. Nevertheless, Bayesian Belief Networks (BBN) are based on probabilistic approaches which display the uncertainty in the evaluation of phenomena in terms of probability. These Networks are essentially developed as tools for analyzing decision-making strategies under uncertainty. Accordingly, this study set out to estimate the potential of the BBN as a relatively new and probable means for estimating the wind erosion and, finally, to evaluate the management scenarios for controlling wind erosion in Isfahan province.

Materials and methods: To start the process of modeling the Bayesian Beliefs networks with regard to the purpose of the study, suitable variables were selected for modeling the BBN by reviewing the related literature and asking the experts opinions. In the next step, the relationships between the variables were determined, using the impact graph. The impact diagram shows the relationships and effects of the variables on each other and on the output node of the model (the amount of wind erosion). Finally, in order to create a model and formulate the conditional probability tables of model variables, the impact diagram was transformed into a BBN model, using the Netica software. The Bayesian Belief Network Model was validated by sensitivity analysis, the results of the analyses carried out by experts, and the comparison of the obtained map of Bayesian model with the wind erosion map in Isfahan province. The ROC curve characterizes the relative performance of each model. The area under this curve is called the AUC and the model with the highest AUC has the highest relative Function. The AUC equals 0.5 equivalent to the neutral model and the closer this value is to 1, the higher the Function of the model would be.

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DOI: 10.22052/deej.2020.9.26.35

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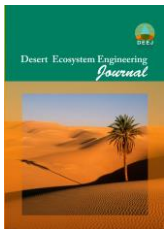

Result: Having applied the final model of Bayesian's belief network, the causal relationships between the variables affecting the rate of wind erosion were shown. The target variable in this model was wind erosion. As the findings of the study indicated, geological variables, land management, topography of the area, soil texture, rainfall and frequency of erosive winds were considered as key variables of the model. In order to run the model, information about each of the key variables was taken from the area at the province and fed into the model. Finally, the model was designed to estimate the amount of wind erosion in each sampling point. Based on the output of the model, the probability of wind erosion in each unit was used to zone the probability of wind erosion in the study area. The overall sensitivity analysis of the model also indicated that the wind erosion rate of the area had the most sensitivity to the wind velocity and speed, the frequency of erosive winds, and the protection of the earth's surface. On the other hand, the least sensitivity was reported for such variables as soil texture, geology and topography. Moreover, a high correlation between the results of the two models was found. According to the results of the ROC curve, the area under the AUC curve for Bayesian network model is 0.79, suggesting acceptable model accuracy.

Discussion and Conclusion: It was shown that the BBN presented the probability of different wind erosion rates for each sampling point in the study area. In BBN, the results are expressed in the probability language and managers are to choose and implement timely and appropriate management decisions to reduce the risk of wind erosion in the region. The designed model in this study could be implemented in all regions. However, depending on the conditions of each region, the number of variables in the model may be increased or reduced. The study used Bayesian belief networks in the critical areas of wind erosion in Isfahan province. This model well demonstrates the importance of implementing wind erosion control projects to assist in sustainable land development to prevent migration, foster agricultural conservation, increase industry development and bio-resources in desert areas with desertification control.

Keywords: Sensitivity analysis, wind erosion, ROC, Bayesian belief networks.